

Canis simensis. By Claudio Sillero-Zubiri and Dada Gottelli

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Canis simensis Rüppell, 1835

Ethiopian Wolf

Canis simensis Rüppell, 1835:39. Type locality "in der Bergen von Simen" [Ethiopia, ca. 13°15'N, 38°00'E].

Canis sinus Gervais, 1855:58. Type locality "Abyssinie."

Canis or *Vulpes walge* Heuglin, 1862a:245. Type locality "Djibara und Eisregion" [13°28'N, 38°30'E, Semien Mountains, Ethiopia, 3,000 m, Yalden et al., 1980].

Canis semiensis Heuglin, 1862a:245. Emendation of *simensis* Rüppell.

Canis walgié Heuglin, 1862b:428. "Semien," Ethiopia, above 10,000 feet. Emendation of *walge* Heuglin.

Simenia simensis Gray, 1868:494. Type locality "Abyssinia."

Vulpes crinensis Erlanger and Neumann, 1900:486. Type locality "Hauasch-Gebiet. Schoa" [central highlands of Addis Ababa, Shoa Region].

Canis (Simenia) simensis citernii de Beaux, 1922:25. Type locality "Arussi: Barofa" [Ethiopia, 07°25'N, 39°19'E, 3,000 m, Yalden et al., 1980].

CONTEXT AND CONTENT. Order Carnivora, Infraorder Canoidea, Family Canidae. Subfamily Caninae (Wozencraft, 1989). Genus *Canis* contains seven species, although the validity of *C. rufus* has been questioned (Clutton-Brock et al., 1976; Ewer, 1973; Wayne, 1993). Two subspecies are currently recognized based on skull structure (Yalden et al., 1980:178) as follows:

C. s. simensis (Rüppell, 1835:39), see above (*walge* Heuglin, *semiensis* Heuglin, *walgié* Heuglin and *Vulpes crinensis* are synonyms).

C. s. citernii (de Beaux, 1922:25), see above.

DIAGNOSIS. *Canis simensis* (Fig. 1) is the largest member of the genus in Africa. It is distinguishable from jackals (*C. aureus*, *C. mesomelas*, *C. adustus*) by its larger size, relatively longer legs, distinctive reddish coat, and white underparts, throat, chest, and tail markings (Gottelli and Sillero-Zubiri, 1990, 1992; Morris and Malcolm, 1977). *C. simensis* has an elongated skull with a slender elongate nose (Fig. 2) (Gray, 1868). The facial length (sensu Driesch, 1976) is 58% of the total skull length. The skull is very flat in profile, with only a shallow angle between frontals and nasals (Heuglin, 1863). The neurocranium is low and narrow, thick, and almost cylindrical (Heuglin, 1863). Its width is 30% of the total skull length. The interparietal crest is slightly developed (Clutton-Brock et al., 1976), and the coronal ridge is linear. The teeth, especially the premolars, are small and widely spaced. The sharply pointed canines average 19 mm long (14 to 22 mm), and the carnassials (P4 and m 1) are relatively small (Clutton-Brock et al., 1976).

GENERAL CHARACTERS. *Canis simensis* has long legs and an elongate muzzle, resembling a North American coyote (*Canis latrans*) in conformation and size (Morris and Malcolm, 1977). Rüppell (1835) compared it to a large German shepherd dog. The pelage of the dorsal and flank regions is soft and short. The overall color is tawny rufous (ochre to rusty red), with a dense whitish to pale ginger underfur. The throat, chest, and underparts are white. There is a distinctive white band around the ventral part of the neck; the inner aspect of the limbs is white. The boundary between the red coat and the white markings is sharp and well defined. The face, the upper part of the slender muzzle, and the dorsal surface of the ears are red. The ears are broad and pointed, and directed forward. They are thickly fringed with long white hairs growing inward from the edge, whereas the inside of the pinnae is almost naked. The palate, gums, and naked borders of the lips are entirely black. The lips, chin, throat, a small spot on the cheeks, and ascending crescent

below the eyes are white; there is a small ochre strip on the chin. The tail is furry; the anterior part is white underneath. The area around the anus is white. The rufous color of the coat continues in a short strip down the back of the tail, becoming a black strip connecting to a thick black brush of guard hairs that have black tips (Heuglin, 1863). There is no dark patch marking the supracaudal gland (in litt.).

Male Ethiopian wolves are significantly larger than females, as in other species of *Canis*. In specimens from the Bale Mountains, males were 20% larger than females in body mass. Adult males had a mass of 14.2-19.3 kg, mean 16.2 ($n = 18$), and females 11.2-14.15 kg, mean 12.8 kg ($n = 8$). Eleven-month-old (yearling) males had a mass of 12.1-14.4 kg, mean 13.35 ($n = 4$), and females 11.1-11.8 kg, mean 11.42 ($n = 3$). Six-month-old males had a mass of 7.6-10 kg, mean 8.9 ($n = 10$), and females 6.1-9.2 kg, mean 7.7 ($n = 8$) (Gottelli and Sillero-Zubiri, 1990; in litt.).

The mean and range of measurements (mm) of 18 adult males trapped in the Bale Mountains were: length of head and body, 963 (928-1,012); length of tail, 311 (290-396); heart girth, 517 (476-558); shoulder height, 593 (573-620); length of hindfoot, 199 (193-209); length of ear, 108 (100-119). Measurements of eight females from the same region were: length of head and body, 919 (841-960); length of tail, 287 (270-297); heart girth, 470 (454-596); shoulder height 544 (530-567); length of hindfoot, 187 (178-198); length of ear, 104 (95-110). Measurements of males were significantly larger than those of females (t -test, $P < 0.05$) for all measurements except ear length. Female dimensions averaged 7% smaller (Gottelli and Sillero-Zubiri, 1990; in litt.).

Mean and range of skull measurements (mm) for skulls of adult *C. s. citernii* ($n = 22$) from the Bale Mountains were: condylobasal length, 186.9 (180-195); greatest length of skull, 200.5 (191-210); greatest breadth of neurocranium, 60.2 (57.4-62.4); least interorbital breadth, 33.2 (30.5-35.8); least skull breadth (postorbital constriction), 36.5 (32.6-40.5); zygomatic breadth, 101.1 (97-106); length of mandible, 150.4 (141-159); length of mandibular cheektooth row, 79.2 (76-83.4). The neurocranial capacity of five skulls, 104 cc (96-111) (in litt.). Methods of taking skull measurements follow Driesch (1976).

DISTRIBUTION. *Canis simensis* is endemic to Ethiopia (Fig. 3), where it is one of several species of mammals restricted to Afro-alpine grasslands and heathlands (Yalden and Largen, 1992). The species is confined to six or seven mountain ranges of the



FIG. 1. Adult male *Canis simensis* from Bale Mountains, Ethiopia. Photo by C. Sillero-Zubiri.



FIG. 2. Dorsal, ventral, and lateral views of cranium, and lateral view of the mandible of *Canis simensis citernii*, male BMNP 1199, from Bale Mountains. Greatest length of cranium is 209 mm. Photographs by T. Dennett.

Ethiopian highlands, at altitudes of 3,000 to 4,400 m (Gottelli and Sillero-Zubiri, 1990, 1992; Morris and Malcolm, 1977; Sillero-Zubiri and Gottelli, 1991a; Yalden et al., 1980). There are no recent records of the species at altitudes below 3,000 m, although specimens were collected at 2,500 m from Gojjam and northwestern Shoa at the beginning of the century (Hilzheimer, 1908; Maydon, 1925; Powell-Cotton, 1902). Its range likely was restricted altitudinally by increasing agricultural pressure (Yalden et al., 1980).

Remnant populations of *C. s. simensis* occur in the Simien Mountains, Mount Guna, Mahal Meda/Menz and Gosh Meda/Ankober, all north of the Rift Valley. *C. s. simensis* populations were reported elsewhere until early this century, e.g., on the Gojjam plateau (Powell-Cotton, 1902; Maydon, 1932); northwestern Shoa,

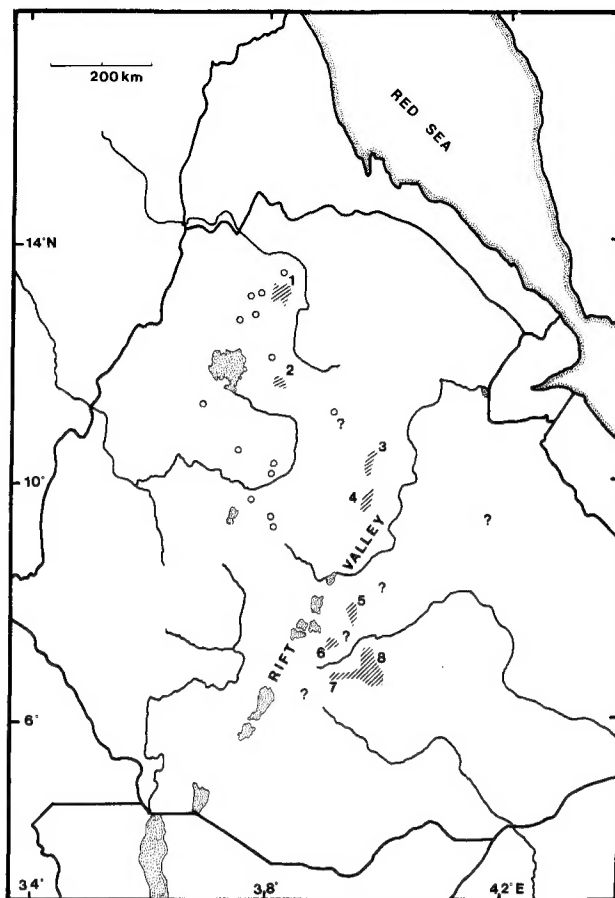


FIG. 3. Geographic distribution of *Canis simensis* in Ethiopia. Open circles indicate records prior to 1925 (Yalden et al., 1980). Question marks indicate uncertain or unconfirmed records. Numbers refer to discrete populations as compiled by Gottelli and Sillero-Zubiri (1992), with area of habitat available and likely adult population size: 1, Simien Mountains, 680 km², 35–90; 2, Mount Guna, 110 km², 10–20; 3, Mahal Meda/Menz, 66 km², 10–20; 4, Gosh Meda/Ankober, 46 km², 10–15; 5, Mount Chilalo/Ticho, 318 km², 30–50; 6, Mount Kaka, 110 km², 15–20; 7, Somkaro/Korduro Mountains, 155 km², 25–35; 8, Bale Mountains National Park, 1,209 km², 205–270.

(Erlanger and Neumann, 1900; Hilzheimer, 1908; Neumann, 1902); southern Gondar and Wollo (Heuglin, 1863, 1868, 1877). There is no evidence that it ever occurred in Eritrea (Coetzee, 1977). With the possible exception of the Wollo highlands, the populations mentioned have since become extinct. Ethiopian wolves have been observed regularly in Simien since they were first described (Bailey, 1932; Brown, 1964a; Heuglin, 1868; Maydon, 1925; Nicol, 1971; Powell-Cotton, 1902), although by 1938 they had decreased such that they required protection (Harper, 1945).

Canis s. citernii is found to the southeast of the Rift Valley in Chilalo, Ticho, and Mount Kaka in Arssi, and in Somkaro and the Bale Mountains. Reports of small populations in Chercher and North Sidamo (Haltenorth and Diller, 1980) may be in error. With probably fewer than 500 individuals surviving (Gottelli and Sillero-Zubiri, 1992), this distinctive carnivore is considered the rarest canid in the world and is classified by IUCN as “endangered” (Ginsberg and Macdonald, 1990). More than half the species’ population live in the Bale Mountains National Park. There is no fossil record of *C. simensis*.

FORM AND FUNCTION. The guard hairs are short and the underfur is thick, providing protection at temperatures as low as -15°C . The molt occurs at the end of the wet season (August–October). There is no evident seasonal variation in coat color, but the contrast of white markings against the red coat increases with age and social rank in both sexes. The female’s coat generally is

paler than the male's; during breeding and pregnancy, the coat turns pale yellow and becomes woolly, and the tail turns brownish, and loses much of its hair. There are eight mammae, but often only six are functional (Gottelli and Sillero-Zubiri, 1990; in litt.).

The front foot has five toes, including a short one with a dew claw proximal to the other four; the hind foot has four toes. The limb posture is digitigrade. The legs are strikingly long and slender, seemingly suitable for coursing in open country. The dental formula is $i\ 3/3$, $c\ 1/1$, $p\ 4/4$, $m\ 2/3$, total 42; $m3$ occasionally is absent (in litt.).

ONTOGENY AND REPRODUCTION. The only information available on the reproductive habits of these animals comes from four years of observations of nine wild packs in the Bale Mountains (Gottelli and Sillero-Zubiri, 1990; Sillero-Zubiri, 1994). The dominant female of each pack gives birth once a year between October and January (Gottelli and Sillero-Zubiri, 1990). Gestation, based on the time from last day of mating to parturition, lasts 60–62 days. Young are born with their eyes closed and without teeth, in a den dug by the female in open ground under a boulder or inside a rocky crevice. Five and six placental scars were counted in the uteri of two females. A 7-week-old unborn litter was composed of three female and two male fetuses, averaging 121.8 g. A 10-day-old female pup had a mass of 650 g. The natal coat is charcoal gray with a buff patch on the chest and inguinal regions. Two to six young emerge from the den after 3 weeks. At this time, the dark natal coat begins to be replaced by the pelage typical of the species. Young are regularly shifted between dens, up to 1,300 m apart. In 8 out of 18 natal dens watched, a subordinate female assisted the mother in suckling the young. At least 50% of extra nursing females showed signs of pregnancy and may have lost or deserted their own offspring before joining the den of the dominant female (Sillero-Zubiri, 1994).

Development of the young is divisible into three stages: (1) early nesting (week 1–4), when the young are entirely dependent on milk; (2) mixed nutritional dependency (week 5–10), when milk is supplemented by solid foods regurgitated by all pack members until young are completely weaned; and (3) postweaning dependency (week 10 to six months), when the young subsist almost entirely on solid foods supplied by helpers. Adults have been observed providing food to juveniles up to one year old. Juveniles will join adults in patrols as early as 6 months of age, but will not urinate with raised leg until 11 months if male or eighteen months if female. Yearlings have 80–90% of adult body mass. Full adult appearance is attained at 2 years. Both sexes become sexually mature during their second year. Only about 60% of females breed successfully each year (Sillero-Zubiri, 1994).

ECOLOGY. Ethiopian wolves live in packs, a discrete and cohesive social unit that communally shares and defends an exclusive territory. Pack members forage and feed alone on small prey, contradicting the general trend in carnivores for grouping and cooperative hunting (Gittleman, 1989). In the Bale Mountains *Canis simensis* is most active during the day feeding almost exclusively upon diurnal small mammals of the high altitude Afro-alpine grassland community, such as the endemic giant mole rat *Tachyoryctes macrocephalus* (300–900 g), and other endemic species such as grass rats *Arvicanthis blicki*, *Lophuromys melanonyx*, and Starck's hare *Lepus starcki* (Gottelli and Sillero-Zubiri, 1990, 1992; Morris and Malcolm, 1977; Yalden, 1988; Yalden and Largen, 1992). Murid rodents accounted for 95.8% of all prey occurrences in 689 feces, with 86.6% belonging to the first three species listed above (Sillero-Zubiri, in press). Other prey species include *Otomys typus*, *Lophuromys flavopunctatus*, and occasionally goslings and eggs. On two occasions wolves were observed feeding on rock hyrax (*Procavia capensis*), and twice on a mountain nyala calf (*Tragelaphus buxtoni*). In other locations where *T. macrocephalus* was absent it may be replaced in the diet by the smaller *T. splendens*. In the Simien mountains, wolves feed upon *Arvicanthis abyssinicus* (Müller, 1977). Undigested leaves of *Carex monostachya* were found in 4.5% of the feces, probably ingested to assist digestion or control of parasites.

Digging prey out is common and is the most favored technique to catch giant mole rats, with the effort expended varying from a few scratches at a rat hole to the total destruction of a set of burrows leaving mounds of earth one meter high (Morris and Malcolm, 1977). Sometimes digging served to reach a nest of grass-rats. Kills often are cached and later retrieved (in litt.). Although the Ethiopian wolf

is a pre-eminent rodent hunter it is also a facultative, cooperative hunter. Occasionally small packs have been seen chasing young antelopes, lambs, and hares and making a kill. Wolves will take carrion or feed on carcasses; in fact a sheep carcass is the most successful bait for trapping. The local name "*Jedallah farda*"—the horse's jackal—refers to the habit of following mares and cows about to deliver and eating the afterbirth. In areas of grazing in Bale wolves were often seen foraging among herds of cattle, a tactic that may aid in ambushing rodents out of their holes, by using the herd as a mobile hide (in litt.).

Annual home ranges of eight packs monitored for 4 years averaged 6.0 km², with some overlap in home ranges. Home ranges in an area of lower prey biomass averaged 13.4 km² ($n = 4$) (Gottelli and Sillero-Zubiri, 1990). Overlap and aggressive encounters between packs were highest during the mating season. Density of wolves in Bale is correlated positively with density of rodent prey and negatively with vegetation height, with the highest concentrations of wolves found in short Afro-alpine herbaceous communities (1 adult/km²), lower densities in *Helichrysum* dwarf-scrub (0.2/km²), and in ericaceous heathlands and barren peaks (0.1/km²). Wolves also are present at low density in montane grasslands at lower elevations. Dispersal movements are tightly constrained by the scarcity of suitable habitat. Males do not disperse and are recruited into multi-male philopatric packs; some females disperse at two years of age and become 'floaters', occupying narrow ranges between pack territories until a breeding vacancy becomes available. Dead breeding females typically are replaced by a resident daughter. Pack adult sex ratio is biased toward males 1.8:1 ($n = 59$).

The most widespread disease to affect *C. simensis* is rabies, likely the main cause of mortality in Bale and probably elsewhere (Gottelli and Sillero-Zubiri, 1992; Tyler, 1975). Cyclic mortality of wild canids and domestic dogs has been reported for Bale (Gottelli and Sillero-Zubiri, 1990; Hillman, 1986; Mebatsion et al., 1992). Two of 15 serum samples of *C. simensis* from Bale tested positive for rabies antibody (Mebatsion et al., 1992). Population decline related to disease has been observed in two study populations in Bale in 1990 and 1992, with losses of up to 75% ($n = 34$ and $n = 48$; Gottelli and Sillero-Zubiri, 1992). Rabies virus was isolated from two carcasses retrieved in 1992 (A. King, pers. comm.). Other causes of mortality include starvation of juveniles between weaning and one year of age, road kills, and shooting. Ethiopian wolves are exceptionally free of ectoparasites, perhaps because of the cold mountain climate; none was found on any of 67 animals handled. Nematodes and trematodes were present in feces and in the gut of several carcasses, one was identified as *Taenia sp.* (perhaps *T. pisiformis*, M. Anwar, pers. comm.).

Where they coexist with Ethiopian wolves, domestic dogs, golden jackals (*Canis aureus*) and serval cats (*Felis serval*) possibly are competitors. There are no known predators, but unattended young might be taken by spotted hyaenas (*Crocuta crocuta*) or the Verreaux eagle (*Aquila verreauxi*—Emmrich, 1985). Dives of tawny eagles (*Aquila rapax*) at small pups elicit swift defense by guarding adults (in litt.).

The species is less common and widely distributed now than in the past (Yalden et al., 1980). The main causes of this decline are loss of habitat to agriculture and grazing, disease, hybridization with domestic dogs, and human persecution (Emmrich, 1985; Gottelli and Sillero-Zubiri, 1992; Gottelli et al., 1994; Mebatsion et al., 1992; Morris and Malcolm, 1977; Yalden et al., 1980).

The highlands of Ethiopia are among the most densely populated agricultural areas within Africa. Habitat destruction and soil degradation have steadily reduced the Afro-alpine ecosystems, which increasingly resemble islands. Extensive overgrazing by livestock probably depresses rodent populations significantly. Some populations of Ethiopian wolves have been exterminated due to their reputation as predators of sheep and goats. Local people in Simien regard them as a menace to sheep, and report that they would come near the pens at night (Brown, 1964a; Emmrich, 1985). However, no trace of wool or long hairs of livestock were found in feces collected from Simien (Brown, 1964a; Nicol, 1971).

Until recently, Ethiopian wolves were unmolested by humans in Bale (Brown, 1964b; Morris and Malcolm, 1977) and did not appear to be regarded as a threat to sheep and goats, which are occasionally left unattended during the day (Gottelli and Sillero-Zubiri, 1990). Brown (1966) and Morris and Malcolm (1977) found no evidence of livestock remains in feces collected in Bale. Only two instances of predation upon lambs were recorded during 1,800 hours

of observation (Sillero-Zubiri and Gottelli, in press). Losses to wolves were dismissed by herders as unimportant when compared to damage by spotted hyaenas. This perception has changed recently, aided by a sudden availability of weapons (Gottelli and Sillero-Zubiri, 1992), and wolves are increasingly being shot. In the past, sport hunters occasionally killed Ethiopian wolves, but the species is now protected by national law. Most of the range of the two largest populations, i.e., Bale and Simien, is protected within National Parks. There is no exploitation for furs or other purposes, although a report from Simien suggested the wolf's liver is used as a medicament (Staehli, 1975). There are no animals in captivity.

The main methods of studying Ethiopian wolves have been direct observation from vantage points of known animals, trapping, and radio-tagging. Wolves were trapped using Victor leg-hold traps (Soft-catch® No. 1½ and No. 3, Woodstream Corporation, Lititz, Pennsylvania, USA), immobilized with 3–4 ml/kg of Telazol (50 mg/ml), and individually marked with plastic ear tags (Rototag, Henley, U.K.). Radiotransmitters were predominantly used to locate the wolves for direct observations.

BEHAVIOR. Packs of 3–13 adults (mean, 6) congregate for social greetings and border patrols at dawn, noon and evenings, and to rest together at night, but break up to forage individually in the morning and early afternoon. Peaks of foraging activity suggest that wolves synchronize their activity with that of rodents above the ground. There is little nocturnal activity, with wolves seldom moving far from their evening resting site. They may become more crepuscular and nocturnal where human interference is severe (e.g., Simien—Brown, 1964b; Somkaro and Kaka, in litt.).

Canis simensis do not use dens to rest at night, and during the breeding season only young and nursing females use the den. Wolves sleep in the open, alone or in groups, curled up, with nose beneath the tail. Several animals may sleep close together. During the cold nights in the dry season a “bed” is carefully prepared from a pile of vegetation debris, the product of giant molerat activity (Yalden, 1985). During the day they take frequent naps, usually resting on their sides. Occasionally, they seek shelter from the rain under overhanging rocks and behind boulders.

Precoital behavior by the dominant female includes an increase in the scent marking rate, play soliciting, food begging towards the dominant male, and agonistic behavior towards subordinate females. The receptive period is synchronized in sympatric females to less than two weeks. Courtship may take place between adult members of a pack or with members of neighboring packs. After a short courtship, which primarily involves the dominant male permanently accompanying the female, wolves copulate over a period of 3–5 days. Copulation involves a tie lasting up to 15 min. Other males may stand by a tied pair with no signs of aggression. Mate preference is shown, with the female discouraging attempts from all but the pack's dominant male, by either defensive snarls or moving away; she is receptive to any visiting male from neighboring packs. Up to 70% of matings ($n = 30$) involved males from outside the pack (Sillero-Zubiri, 1994).

During the breeding season social gatherings are more common and take place next to the den. Intense, energetic, and noisy greetings that occur primarily when groups form or before tandem-marking patrols seem to be an important component in keeping cohesion and friendly relations within the pack. Other common interactions are food sharing, allogrooming, nibbling, and playing, which involves chasing, ambushing, and mock fighting. Strong affiliative ties are developed between siblings during the first months of their life. Vicious play-fighting during the first weeks outside the den may determine the establishment of rank between siblings. Hierarchies among pack members are well established with frequent displays of dominance and subordination as seen in other canids (Fox, 1971). A dominance rank develops among adults of each gender; shifts in rank may occasionally take place in males but not among females (Sillero-Zubiri and Gottelli, 1994).

Calls can be grouped into two categories: alarm calls, given at the scent or sight of man, dogs, or unfamiliar wolves, start with a “huff” (rapid expulsion of air through mouth and nose), followed by a quick succession of high-pitched “yelps” (a series of 4–5 “yeahp-yeahp-yeahp-yeahp”) and “barks.” “Yelps” and “barks” can be also given as contact calls, and often attract nearby pack mates. Greeting calls include a “growl” of threat, a high-frequency “whine” of submission, and intense “group yip-hows,” given at the reunion of pack members and advertise pack size, composition and position.

A “lone howl” and a “group howl” are long-distance calls used to contact separate pack members and can be heard up to 5 km away. Howling by one pack of wolves may stimulate howling in adjacent packs. Communal calls mustered pack members before a border patrol. Ethiopian wolves have an unusually good “winding” sense of smell for a carnivore. They bolt more readily at scent than sight of man (Brown, 1966).

Many postures and habits of the Ethiopian wolf are typical of other social canids. It grooms itself by licking and nibbling and by reciprocating attention of others. It laps water with its tongue. Wolves often wade streams and swim across narrow rivers when necessary. Posture and facial expressions are similar to those described by Fox (1971). Ethiopian wolves remain playful throughout their lives, particularly between male siblings.

Rich food patches are carefully explored by wolves walking slowly, pausing frequently to investigate holes or to localize the rodents by hearing. Once a prey is located, the wolf moves stealthily towards it, taking short steps, and freezing, sometimes with its belly pressed flat to the ground. The quarry is grabbed with the mouth after a short dash. A stalk can last from seconds to up to one hour, in the case of a giant molerat. Occasionally, wolves run in zig-zags across rat colonies picking up the rodents in passing.

Scent marking of territory boundaries, via urine posts, scratching, feces, and vocalizations, are common and function in advertising and maintaining territories (Sillero-Zubiri and Gottelli, in litt.). Adult wolves hunt alone but travel in packs when patrolling their territories at dawn, evening, and often at noon. All pack members, independent of social rank, regularly scent-mark objects along territory boundaries with raised leg urinations and scratches. Tandem-marking trips along territory boundaries are regularly carried out by the whole pack including subadults and juveniles. More often only adults of both sexes take part, led by one of the dominant pair, usually the female. Vocalizations and deposition of feces on conspicuous sites (mounds, rocks, bushes) also play a role in territory defense. Aggressive interactions with neighboring packs are common, highly vocal and always end with the smaller group fleeing from the larger (Sillero-Zubiri and Gottelli, 1994).

GENETICS. In western areas of Bale some wolves had light coats, heavily built bodies, and kinky tails (Sillero-Zubiri and Gottelli, 1991b; Gottelli et al., 1994). One melanistic female was heavier than any other female captured, did not belong to any pack, and gave birth outside the breeding season; she twice lost her offspring after birth. These morphological alterations were apparent only where Ethiopian wolves were sympatric with domestic dogs and it was suggested that they were the product of hybridization with dogs (Sillero-Zubiri and Gottelli, 1991b). Gottelli et al. (1994), using analysis of mitochondrial DNA restriction fragments and microsatellite alleles, concluded that hybridization was common in areas with sympatric dogs, and was due only to crosses between female Ethiopian wolves and male domestic dogs. Elsewhere the dynamics of a dwindling population of Ethiopian wolves in Simien may be affected by introgression; one male was often seen associating with golden jackals, and even attempting to mate (Nicol, 1971). Two contiguous populations in Bale were not differentiated genetically, and microsatellite and mitochondrial DNA variability in both was small relative to other canid species, suggesting small population sizes may have characterized the recent evolution of *C. simensis* (Gottelli et al., 1994).

REMARKS. *Canis simensis* is sometimes called the Simien or Simenian fox (e.g., Allen, 1939; Morris and Malcolm, 1977), but is not closely linked to the *Vulpes* group (Clutton-Brock et al., 1976). Gervais (1855), Gray (1868) and Rothschild (1901) preferred to call it the Abyssinian wolf. It is known throughout Ethiopia by its Amharic name, “*ky kebero*,” which translates as red jackal (Sillero-Zubiri and Gottelli, 1991a). In southeastern Ethiopia it is also known by its Oromo name of “*jedalla farda*”—horse's jackal—which describes the habit of foraging among livestock. Other vernacular names include Simien jackal, simenian jackal, red fox and Ethiopian jackal (Clutton-Brock et al., 1976; Sheldon, 1992).

Clutton-Brock et al. (1976) noted that *C. simensis* is the most distinct species in the genus *Canis*, but suggested close affinity with *Canis adustus* and *Dusicyon* sp. Van den Brink (1973) also denoted affinity with South American canids, and suggested that *C. simensis* was more primitive than *C. adustus*, existing as a distinct form when the genus *Canis* was still undergoing speciation at end of the Oli-

gocene (van den Brink, 1973). Gray (1868) placed *C. simensis* in a separate genus *Simenia*, a classification followed by Allen (1939). Separate generic status was not supported by Cutton-Brock et al. (1976) due to the close similarity of cranial and dental characters with *C. adustus*. A recent phylogenetic analysis of 2,001 pairs of mitochondrial DNA sequence suggested that *C. simensis* is a distinct species, more closely related to the gray wolf (*C. lupus*) and the coyote (*C. latrans*) than to any African canid (Gottelli et al., 1994). *Canis simensis* may be an evolutionary relict of a gray wolf-like ancestor past invasion of northern Africa from Eurasia (Gottelli et al., 1994), where fossils of wolf-like canids are known from the late Pleistocene (Kurtén, 1968).

De Beaux (1922) considered populations from opposite sides of the Rift Valley to be taxonomically distinct, describing the southern subspecies *C. s. citernii* based on the bright red coloration of some specimens. Yalden et al. (1980) considered this character unreliable for a taxonomic distinction but accepted de Beaux's classification on the basis of skull structure, with the nasal bones from wolves southeast of the Rift consistently longer than those from the typical race northwest of the Rift.

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LITERATURE CITED

- ALLEN, G. M. 1939. A checklist of African mammals. Bulletin of the Museum of Comparative Zoology, 83:1-763.
- BAILEY, A. M. 1932. The heights of the Simien. Natural History (New York), 23:61-74.
- VAN DEN BRINK, F. H. 1973. Distribution and speciation of some carnivores-2. Mammal Review, 3:85-95.
- BROWN, L. H. 1964a. Semien fox. *Africana*, 2:45-48.
- . 1964b. A report on the mountain nyala *Tragelaphus buxtoni*, the Semien fox *Simenia simensis*, and other animals in the Mendebo mountains, Bale Province, Ethiopia. World Wildlife Fund report, Nairobi, Kenya, Mimeo 18 pp.
- . 1966. A report on the National Geographic Society/World Wildlife Fund Expedition to study the Mountain Nyala *Tragelaphus buxtoni*. World Wildlife Fund report, Nairobi, Kenya, Mimeo 118 pp.
- COETZEE, C. G. 1977. Order Carnivora. Pp. 1-42, in The mammals of Africa. An identification manual (J. Meester and H. W. Setzer, eds.). Smithsonian Institution Press, Washington DC, 481 pp.
- CLUTTON-BROCK, J., G. B. CORBET, AND M. HILLS. 1976. A review of the family Canidae, with a classification by numerical methods. Bulletin of the British Museum (Natural History), Zoology Series, 29:117-199.
- DE BEAUX, O. 1922. Mammiferi Abyssini e Somali. Atti della Società Italiana di Scienze Naturali, 61:21-34.
- DRIESCH, A. 1976. A guide to the measurement of animal bones from archaeological sites. Peabody Museum Bulletin (Harvard University), 1:1-125.
- VON EMMERICH, D. 1985. Der Abessinische Wolf, *Simenia simensis* (Rüppell, 1835), Beobachtungen im Bale-Gebirge. Zoologische Garten N. F., Jena, 55(5/6):327-340.
- VON ERLANGER, C., AND O. NEUMANN. 1900. Über ihre Reisen in Nordost-Afrika. Verhandlungen Geissellschaft für Erdkunde, Berlin, (9-10):477-486.
- EWER, R. F. 1973. The carnivores. Cornell University Press, Ithaca, New York, 494 pp.
- FOX, M. W. 1971. Behaviour of wolves, dogs and related canids. Harper & Row, New York, 220 pp.
- GERVAIS, M. P. 1855. Histoire Naturelle des Mammifères. L. Curmer, Paris, 2:1-344.
- GINSBERG, J. R., AND D. W. MACDONALD. 1990. Foxes, wolves, jackals and dogs. An action plan for the conservation of canids. IUCN/SSC Canid Specialist Group and Wolf Specialist Group. IUCN, Gland, Switzerland, 116 pp.
- GITTLEMAN, J. L. 1989. Carnivore group living: comparative trends. Pp. 183-207, in Carnivore behavior, ecology and evolution (J. L. Gittleman, ed.). Chapman and Hall, London, 620 pp.
- GOTTELLI, D., AND C. SILLERO-ZUBIRI. 1990. The Simien jackal: ecology and conservation. Wildlife Conservation International report, New York Zoological Society, 106 pp.
- . 1992. The Ethiopian wolf—an endangered endemic canid. *Oryx*, 26:205-214.
- GOTTELLI, D., ET AL. 1994. Molecular genetics of the most endangered canid: the Ethiopian wolf, *Canis simensis*. *Molecular Ecology*, 3:301-312.
- GRAY, J. E. 1868. Notes on the skulls of the species of dogs, wolves and foxes (Canidae) in the collection of the British Museum. Proceedings of the Zoological Society of London, 1868:492-525.
- HALTENORTH, T., AND H. DILLER. 1980. A field guide to the mammals of Africa. Collins, London, 400 pp.
- HARPER, F. 1945. Extinct and vanishing mammals of the Old World. Special Publication 12. American Committee for International Wildlife Protection, New York, 850 pp.
- VON HEUGLIN, T. 1862a. Die vertikale Verbreitung der Säugethiere und Vögel in Abessinien. Petermann's geographische Mitteilungen, Heft VII:244-246.
- . 1862b. Reise der Herren Th. v. Heuglin, Dr Steudner und H. Schubert in östlichen Theile des Hochlands von Abessinien, Februar bis Mai 1862. Petermann's geographische Mitteilungen, Heft XI:424-428.
- . 1863. Beiträge zur Zoologie Afrika's. Über einige Säugethiere des Bäschlo-Gebietes. Nova Acta Academiae Caesarea Leopoldino-Carolinae Germanicum Naturae Curiosorum, 30(2): 1-14.
- . 1868. Reise nach Abessinien, den Gala-Ländern, Ost Sudan, und Chartum, in den Jahren 1861 und 1862. Hermann Costenoble, Jena, 459 pp.
- . 1877. Reise in Nordost-Afrika. Schilderungen aus dem Gebiete der Beni Amer und Habab nebst zoologischen Skizzen und einem Führer für Jagdeisende. George Westermann, Braunschweig, 2:1-304.
- HILLMAN, J. C. 1986. Bale Mountains National Park Management Plan. Ethiopian Wildlife Conservation Organisation, Addis Ababa, Ethiopia, 322 pp.
- HILZHEIMER, M. 1908. Beitrag zur kenntnis der nordafrikanischen Schakale, nebst Bemerkungen über deren Verhältnis zu den Haushunden, insbesondere nord-afrikanischen und altägyptischen Hunderassen. *Zoologica*, Stuttgart, 20(53):1-111.
- KURTÉN, B. 1968. Pleistocene mammals of Europe. Aldine Publishing Company, Chicago, 317 pp.
- MAYDON, H. C. 1925. Simien, its heights and abysses. H. F. & G. Witherby, London, 244 pp.
- . 1932. Big game shooting in Africa. Seeley Service & Company, Ltd., London, 445 pp.
- MEBATSON, T., C. SILLERO-ZUBIRI, D. GOTTELLI, AND J. H. COX. 1992. Detection of rabies antibodies by ELISA and RFFIT in unvaccinated dogs and in the endangered Simien Jackal (*Canis simensis*) of Ethiopia. *Journal of Veterinary Medicine* B, 39:233-235.
- MORRIS, P. A., AND J. R. MALCOLM. 1977. The Simien fox in the Bale Mountains. *Oryx*, 14:151-160.
- MÜLLER, J. P. 1977. Populationsökologie von *Arvicanthus abyssinicus* in der grasstepe des Simien Mountains National Park (Äthiopien). *Zeitschrift für Säugetierkunde*, 42:145-172.
- NEUMANN, O. 1902. From the Somali coast through southern Ethiopia to the Sudan. *Geographical Journal*, 20:373-400.
- NICOL, C. 1971. From the roof of Africa. Hodder & Stoughton, 362 pp.
- POWELL-COTTON, P. H. G. 1902. A sporting trip through Abyssinia. Rowland Ward, Ltd., London, 531 pp.
- ROTHSCHILD, W. 1901. Exhibition of, and remarks upon, a specimen of the Abyssinian wolf (*Canis simensis* Rüpp.). Proceedings of the Zoological Society of London, 2:283-284.
- RÜPPEL, E. 1835-1840. Neue Wirbelthiere zu der Fauna von Abyssinien gehörig, Säugethiere. Siegmund Schmerber, Frankfurt am Main, 40 pp.
- SHELDON, J. W. 1992. Wild dogs. The natural history of the nondomestic canidae. Academic Press Inc., San Diego, California, 248 pp.
- SILLERO-ZUBIRI, C. 1994. Behavioural ecology of the Ethiopian wolf, *Canis simensis*. DPhil thesis, University of Oxford, United Kingdom, 283 pp.
- SILLERO-ZUBIRI, C., AND D. GOTTELLI. In press. Diet and feeding

- behavior of Ethiopian wolves (*Canis simensis*). *Journal of Mammology*.
- SILLERO-ZUBIRI, C., AND D. GOTTELLI. 1991a. Conservation of the endemic Ky Kebero *Canis simensis*. *Walia*, 13:35-46.
- . 1991b. Domestic dogs may doom endangered jackal. *Wildlife Conservation* (New York), 94(2):15.
- STAEHLI, P. 1975. Report on Simien Mountains National Park. *WWF Yearbook*, 1974-75:130-131.
- TYLER, S. 1975. The Simien fox. *Wildlife*, 17:564-565.
- WAYNE, R. K. 1993. Molecular evolution of the dog family. *Trends in Genetics*, 9:218-224.
- WOZENCRAFT, W. C. 1989. Classification of the recent Carnivora. Pp. 569-593, in *Carnivore behavior, ecology and evolution* (J. L. Gittleman, ed.). Chapman and Hall, London, 620 pp.
- YALDEN, D. W. 1985. *Tachyoryctes macrocephalus*. *Mammalian Species*, 237:1-3.
- . 1988. Small mammals of the Bale Mountains, Ethiopia. *African Journal of Ecology*, 26:281-294.
- YALDEN, D. W., AND M. J. LARGEN. 1992. The endemic mammals of Ethiopia. *Mammal Review*, 22:115-150.
- YALDEN, D. W., M. J. LARGEN, AND D. KOCK. 1980. Catalogue of the mammals of Ethiopia. 4. Carnivora. *Monitore Zoologico Italiano* (n.s. suppl), 13(8):169-272.
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